

Remarks and Arguments

Claims 1-19 have been presented for examination. Claims 1, 9 and 17-19 have been amended.

Claims 1, 3-5, 9, 11-13, 17 and 19 have been rejected under 35 U.S.C. §102(e) as anticipated by U.S. Patent No. 6,745,384 (Biggerstaff.) The examiner comments that the limitations of these claims are disclosed in Biggerstaff Figure 33 and accompanying text.

In response, the independent claims 1, 9 and 17-19 have been amended to recite that the invention processes software source code by replacing a variable looping statement with a constant looping statement in order to enable loop enrolling. Claim 1 is representative. It recites "A method executed in a computer system for processing software source code with a variable looping statement having a loop index, an initial expression and an exit expression wherein at least one of the initial and exit expressions depends on a variable other than the loop index, to enable loop unrolling, comprising ... replacing the variable looping statement in the software source code with a constant looping statement..." This processing method in which one type of loop statement is replaced with another type of loop statement is clearly not shown in the Biggerstaff reference. Biggerstaff allows a user, via user-defined transforms to annotate high level source code statements with optimization tags that cause low level code routines that are generated for each of the high level code statements to be shared. The efficiency of the program is thus increased.

As indicated in Biggerstaff Figure 33 in certain cases, the optimization tags can be applied to nested loop program statements. These optimizations cause expressions involving inner loop indices that are combined with constants to be replaced by a variable whose value is equal to the value of the expression. These replacements prevent the expression from being evaluated each time the loop is processed and decrease the loop execution time. This is what is illustrated in Biggerstaff Figure 33. The optimized loop is illustrated in Biggerstaff Figure 34 in which the expressions I-1 and I+1 have been replaced by variables IM1 and IP1, respectively, and expressions J-1 and J+1 have been replaced by variables JM1 and JP1, respectively.

However, it is clear that Biggerstaff Figure 33 does not disclose “determining from the initial expression and the exit expression, a constant upper bound” and determining from the initial expression and the exit expression, a constant lower bound” where the upper bound and the lower bound define a range of values for a loop index within a constant looping statement as recited in amended claim 1. In Biggerstaff Figure 33, in the variable looping statement in line 1, the initial expression is $i=0$, the exit expression is $i<m$ and i is the loop index. The remainder of the code lines in Figure 33 does not use these expressions to generate constant upper and lower bounds that define a range of values for a loop index in a constant looping (for) statement. The only other looping statement in Figure 33 is: {for $j=0$, $j<n$; $j++$ } in which the upper and lower bounds are 0 and n , which are not constants.

Therefore, it is clear that amended claim 1 recites limitations not disclosed in Biggerstaff and, consequently, patentably distinguishes thereover. Claims 9 and 17-19 contain parallel limitations and also distinguish over the cited reference in the same manner as amended claim 1.

Claims 3-5 are dependent, either directly or indirectly on amended claim 1 and incorporate the limitations thereof. Therefore, they distinguish over the cited reference in the same manner as amended claim 1. In addition, these claims contain additional limitations not disclosed in the cited Biggerstaff reference. Claims 3-5 recite that the upper and lower bounds of the constant looping statement are determined from the initial and exit expressions of the variable looping statement. It should also be noted that, since claim 3 depends from claim 1, that the upper and lower bounds as determined in the manner recited in claims 4 and 5 replace the initial and exit expressions in the variable looping statement when that statement is replaced by the constant looping statement. This is not the case in Biggerstaff where a comparison of Figure 34, which indicates the looping statement after the transformation disclosed in Biggerstaff with the pre-transformation looping statement shown in Figure 33 indicates that the initial and exit expressions remain the same. Therefore, claims 3-5 patentably distinguish over the cited reference. Claims 11-13 contain parallel limitations and distinguish over the cited reference in the same manner as claims 3-5.

Claims 6-8 and 14-16 have been rejected under 35 U.S.C. §103(a) as obvious over Biggerstaff. The examiner comments that Biggerstaff discloses all of the claimed limitations with the exception that it discloses an increasing loop index rather than the decreasing loop index as recited in the claims. The examiner considers the differences to be an obvious expedient. Since the limitation of claim 6-8 and 14-16 parallel those in claims 3-5 and 11-13, with the exception that the loop index decreases instead of increases the comments above with respect to claims 3-5 also apply to claims 6-8 and 14-16. Thus, claims 6-8 and 14-16 patentably distinguish over the cited reference in the same manner as claims 3-5.

Claims 2 and 10 have been rejected under 35 U.S.C. §103(a) as obvious over Biggerstaff in view of U.S. Patent No. 6,438,747 (Schreiber.) The examiner asserts that Biggerstaff discloses all of the limitations as claimed with the exception that it does not disclose forming a condition under which the body statement of the constant loop are executed by ANDing conditions in the initial and exit expressions. However, the examiner contends that Schreiber discloses an AND operator and that it would have been obvious to combine the references in order to verify that the conditions are true.

The Schreiber reference discloses a parallel processing arrangement for iterated loops in which iterations of nested loops are mapped into an array that can be operated in parallel by the multiple processors. The examiner points to an AND operator in one of the example loops and suggests that it could be substituted for the OR operators that are disclosed in Biggerstaff. However, Schreiber and Biggerstaff are unrelated and directed to different problems. Thus, Schreiber can give no motivation to substitute an AND operator for an OR operator in a specific unrelated context. Applicants are not contending that both AND and OR operators are well-known. However, their use in a specific context for a specific purpose cannot be suggested by references that are not related and neither of which are addressed to the problem solved by applicant's invention. Thus, claims 2 and 10 patentably distinguish over the cited combination of references.

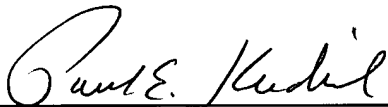
Claim 18 has been rejected under 35 U.S.C. §103(a) as obvious over Biggerstaff in view of U.S. Patent No. 6,009,272 (Goebel.) The examiner states that Biggerstaff discloses all of the claimed limitations with the exception that it does not explicitly

disclose a computer data signal. However, the examiner comments that Goebel discloses digital carrier waves and that it would have been obvious to combine Biggerstaff and Goebel to allow sending of the Biggerstaff program over a carrier.

Amended claim 18 contains limitations that parallel those in amended claim 1. Thus, as discussed above, it patentably distinguishes over the Biggerstaff reference. Goebel discloses a technique for allocating set of virtual registers during code compilation. Since it is not directed to processing looping statements, it cannot supply the limitations missing in Biggerstaff. Thus, claim 18 is patentable over the combination of Biggerstaff and Goebel.

In light of the forgoing amendments and remarks, this application is now believed in condition for allowance and a notice of allowance is earnestly solicited. If the examiner has any further questions regarding this amendment, he is invited to call applicants' attorney at the number listed below. The examiner is hereby authorized to charge any fees or direct any payment under 37 C.F.R. 1.17, 1.16 to Deposit Account number 02-3038.

Respectfully submitted



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